BULLETIN

OF THE INSTITUTE OF METALS

VOLUME I JANUARY 1952 PART 5

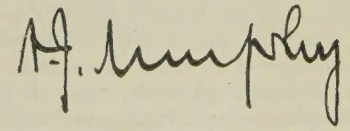
NEW-YEAR MESSAGE FROM THE PRESIDENT

As the Institute moves into the forty-third year of its existence I see no sign of its losing the zest of its youth and the capacity for adaptation to changing circumstances. We have given a liberal interpretation of our objects by organizing meetings for the metal physicist, the metallurgical engineer, and lately the metal economist, as well as catering for the needs of the physical metallurgists who still form the majority of our membership. The change in the format of the *Journal* was a bold step which could only have been taken by an organization sure of the soundness of its constitution.

With these grounds for confidence we may face the New Year in a spirit of optimism and with a belief that we have many useful functions to perform. There is, however, one condition which must be fulfilled if we are to continue to serve the needs of metallurgical science and industry. That condition is to increase our numbers. Our membership has expanded at a steady rate for many years, and each increase enables us to administer our affairs with greater efficiency and economy. But of late the costs of paper, printing, and services generally have risen at a disturbing rate. We have received generous support from industry in the way of contributions to the Industrial Donations Fund, but this can only be of lasting benefit to the Institute if it is accompanied by a substantial expansion of membership during the next few years. An important part of our costs consists of expenses which run at about the same level whatever our numbers, and it is clearly advantageous to spread these overheads over the greatest possible number of subscribing members.

There is no better way in which the individual member can help the Institute at the present time than by bringing to the notice of non-members the services which the Institute offers. With our range of activities as wide as it is now, there can be few concerned in any way with non-ferrous metals who would not derive real advantage from membership. We have a well-devised organization at Grosvenor Gardens ready to follow up energetically an introduction to a potential member: in fact all that is necessary is that the Secretary should be informed of the names of individuals who might be approached. We have no desire to press or inveigle into membership those whose real interests lie elsewhere; it is rather that we are anxious to see the Institute enjoying the benefit which can follow from association in the largest numbers of those sharing our aims and problems. I think there is no loss of dignity for the Institute in striving towards this end.

To all members of the Institute, at home and overseas, in industry, science, and commerce, I wish happiness and prosperity in 1952. May we advance towards the true peace and tranquillity in which we can make our best contribution to real progress.



INSTITUTE NEWS

Appeal to Industry for Regular Financial Support of the Institute's Work

The following additional contributions have been received in response to the Council's appeal to industry for regular financial support of the work of the Institute.

The Council will be grateful for subscriptions (particularly subscriptions under covenant) and donations from companies in the metallurgical and engineering industries which have not yet responded to this appeal.

B. Subscription to be Renewed Annually (without Obligation), but not Under Covenant.

	£	s.	d.
Deloro Stellite, Ltd.	20	0	0

C. Donations (some of which may be Renewed Annually).

Allen (W. H.), Sons and Co., Ltd.	105	0	0
Messina (Transvaal) Development Co., Ltd., The	25	0	0
Elliott Brothers (London), Ltd.	10	0	0
Barnard (H. B.) and Sons, Ltd.	5	5	0
Blackwell's Metallurgical Works, Ltd.	5	5	0
Cohen (Leonard), Ltd.	5	5	0
Corfield-Sigg, Ltd.	5	5	0
Beryllium and Copper Alloys, Ltd.	2	2	0

Council : Representation of The Admiralty

Captain (E.) H. J. B. GRYLLS, R.N., has been nominated to represent The Admiralty at Council meetings of the Institute, in place of Captain (E.) L. A. B. Peile, D.S.O., M.V.O., R.N.

National Committee for Crystallography

MR. H. W. L. PHILLIPS, M.A., has been appointed as representative of the Institute on the National Committee for Crystallography, in succession to Mr. D. A. Oliver, whose term of appointment ended on 31 December 1951.

" Thermodynamics of Alloys "

The Institute is about to publish a monograph entitled " Thermodynamics of Alloys ", which has been specially written at the invitation of the Council by Mr. John Lumsden of the Research Department of Imperial Smelting Corporation, Ltd., Avonmouth.

The monograph deals with the application of thermodynamics to the quantitative study of metals and alloys. The fundamental theory of the subject is presented first, and is followed by some illustrative calculations on pure metals. Then the theory of solutions is developed and exemplified by calculations on solid and liquid alloys. Emphasis is laid on the usefulness of thermodynamics for the accurate correlation of various equilibrium properties, and attention is particularly directed to the information that can be deduced from phase boundaries. Detailed calculations are presented on some typical systems for which measurements of vapour pressures, electrode potentials, and heats of mixing are available; these results are combined with a study of liquidus, solidus, and solid-solubility curves to derive the activities of both components in the liquid and solid phases. It is shown how a free-energy equation for a system, deduced from a suitable set of accurate experimental measurements, furnishes a reliable basis for calculating other equilibrium properties. To assist in numerical calculations, tables of functions that continually recur in thermodynamic problems are provided. Elementary statistical mechanics is introduced for calculating the entropy of gases and for interpreting the form of free-energy curves in solid and liquid alloys. A critical study is made of the extent to which liquid alloys behave as " regular solutions ".

The published price of the monograph, which contains approximately 400 pages, will be 35*s.* ($5.50) post free. As a privilege of membership, members are entitled to purchase one copy at 17*s.* 6*d.* ($3.00) post free.

" Metallurgical Abstracts " Volumes Wanted

The Institute will pay £1 each for bound volumes in good condition, of *Metallurgical Abstracts*, 1942 (vol. 9) and 1943 (vol. 10). Copies offered for sale should be addressed to the Secretary.

Abstractors Wanted

The Editor would be interested to hear of suitably qualified members who would be prepared to assist in the abstracting of the Russian and Italian scientific and technical literature.

Election of Members

The following 10 Ordinary Members, 3 Junior Members, and 23 Student Members were elected on 20 November 1951 :

As Ordinary Members

DUFFELL, James, Works Manager, Lees and Sanders, Ltd., Warstone Smelting Works, Birmingham 18.

ELLIOTT, Bernard, Managing Director, Higher Speed Metals, Ltd., Brocco Street, Sheffield 3.

GARSIDE, Frederick Charles, Commissioner for Railways, New South Wales, 19 York Street, Sydney, N.S.W., Australia.

HORSEFIELD, Alec Matthew, B.A., Research Metallurgist, Electrode Development Laboratory, The Quasi-Arc Company, Ltd., Bilston, Staffs.

MCLENNAN, John Ewan, Experimental Officer, Department of Supply, Commonwealth of Australia, Canberra House, 87 Jermyn Street, London, S.W.1.

SERVI, Italo S., S.M., Sc.D., Research Metallurgist, Union Carbide and Carbon Research Laboratories, Inc., Niagara Falls, N.Y., U.S.A.

STILES, J. Barrington, J.P., Director, The Metallizing Equipment Company, Ltd., Metco Works, Cobham, Surrey.

TAYLOR, George Oswald, Technical Librarian, T.I. Aluminium, Ltd., Redfern Road, Tyseley, Birmingham 11.

WARREN, Gordon Frederick, Technical Editor, " Wire Production ", 356–358 Kilburn High Road, London, N.W.6.

WILSON, William, Jr., M.S., Research Metallurgist, Armour Research Foundation, 35 West 33rd Street, Chicago 16, Ill., U.S.A.

As Junior Members

JONES, Graham Benjamin, B.Sc., Research Metallurgist, The Bristol Aeroplane Company, Ltd., Engine Division, Filton, Bristol.

MARKSON, Desmond, Junior Metallurgist, Enfield Rolling Mills, Ltd., Brimsdown, Enfield, Middlesex.

SABATO, Jorge Alberto, Director, Scientific Department, Guillermo Decker SRL, Buenos Aires, Argentina.

As Student Members

ANANTHARAMAN, Tanjore Ramachandra, M.A., M.Sc., Research Student, Inorganic Chemistry Laboratory, South Parks Road, Oxford.

ASTON, Kenneth, Student Metallurgist, Stewarts and Lloyds, Ltd., Bilston, Staffs.

BOSTON, Stanley John, Student of Metallurgy, Humber, Ltd., Coventry.

CLEAVE, John F., Student Metallurgist, The Bristol Aeroplane Company, Ltd., Engine Division, Filton, Bristol.

EBDON, Denis Keith, Student of Metallurgy, Battersea Polytechnic, London, S.W.11.

FORD, Ashley Gregg, Assistant, Metallurgical Laboratory, Alfred Herbert, Ltd., Coventry.

GWINNETT, Francis Edgar, Student Metallurgist, Stewarts and Lloyds, Ltd., Bilston, Staffs.

HARRIES, Donald Rees, B.Sc., Research Student, Metallurgy Department, University of Cambridge.

HARTREE, Oliver P., B.A., Assistant Metallurgist, The Bristol Aeroplane Company, Ltd., Engine Division, Filton, Bristol.

HUTTON, Gilbert Jerome, B.S., Student of Metallurgical Engineering, University of Toronto, Ont., Canada.

JOHNSON, Roy Harold, Student Metallurgical Apprentice, Stewarts and Lloyds, Ltd., Bilston, Staffs.

JONES, Thomas Ivor, Student of Metallurgy, University College, Cardiff.

MARTIN, Alan Howard, Student Metallurgical Apprentice, Stewarts and Lloyds, Ltd., Bilston, Staffs.

MILLER, D. Ross, B.Sc., Research Scholar, Baillieu Laboratory, University of Melbourne, Melbourne, Vic., Australia.

PAYNE, Maurice David, Assistant, Metallurgical Laboratory, Lockheed Hydraulic Brake Company, Ltd., Leamington, Warwickshire.

POWELL, Richard, Student Metallurgical Apprentice, Stewarts and Lloyds, Ltd., Bilston, Staffs.

SHARMA, Harish Chandra, E-30, Connaught Place, New Delhi 1, India.

SPRIGGS, G. E., Student of Metallurgy, Powderloys, Ltd., Torrington Avenue, Coventry.

UGLOW, Alan G., Student of Metallurgy, Battersea Polytechnic, London, S.W.11.

WARD, Robert George, B.A., Research Student, Metallurgy Department, University of Cambridge.

WHITTAKER, Gordon, Student Metallurgical Apprentice, Stewarts and Lloyds, Ltd., Bilston, Staffs.

WILDGOOSE, Paul, Student Metallurgist, The Bristol Aeroplane Company, Ltd., Engine Division, Filton, Bristol.

WILLIAMSON, George Kingsley, B.Sc., Ph.D., Research Fellow, Metallurgy Department, University of Birmingham.

PERSONAL NOTES

MR. T. R. ALLMAND has taken up an appointment as an Assistant Metallurgist in the Research and Development Department of The David Brown Foundries Co., Ltd., Penistone.

DR. J. L. ASTON has taken up a post in the Science Department of the County Technical College, Wednesbury.

MR. M. G. BADER has been awarded the degree of B.Sc. in metallurgy at London University. He is leaving The de Havilland Aircraft Co., Ltd., in order to complete his National Service.

MR. W. M. BARTLETT has just been awarded the Ph.D. degree of the University of Wales.

DR. HORACE W. CLARKE recently visited America as one of a team of British industrialists who attended the first International Conference of Manufacturers.

MR. A. H. COX is now a metallurgist with D. Napier and Sons, Ltd., Luton.

DR. E. A. G. CROOM has recently taken up a post as metallurgist with the English Electric Co., Ltd., Stafford.

MR. D. DAVIES has left The Mint, Birmingham, Ltd., to take up a position as Metallurgist to Aluminium Die-Castings (Birmingham), Ltd.

MR. R. J. GOODWIN has left the British Non-Ferrous Metals Research Association, where he was a Bursar, to take up an appointment as Assistant Metallurgist to The Manganese Bronze and Brass Co., Ltd., Ipswich.

MR. C. C. HANSON has been appointed Metallurgist and Technical Adviser to High Grade Steels, Ltd., Hall Green, Birmingham.

MR. J. B. HAWORTH, Research Metallurgist with Murex, Ltd., has been awarded the D.Phil degree of Oxford University.

MR. D. MACKENZIE has left John Brown and Co., Ltd., to take up an appointment as Works Manager to Rhodesian Alloys, Ltd., P.O. Box 530, Gwelo, Southern Rhodesia.

MR. K. LOVEDAY has taken up a post as metallurgist with The Plessey Co., Ltd., Research and Development Division, Ilford.

DR. A. B. A. MURAD has returned to Egypt, having completed his studies at the Royal Technical College, Glasgow.

MR. T. PARRY has been appointed a Director of the Robin Hood Cycle Co., a subsidiary of Raleigh Industries, Ltd., Nottingham.

MR. S. A. PRICE has left for Canada, where his address will be: Cametoid, Ltd., Ajax, Ont.

MR. T. HOWARD ROGERS has been appointed Officer-in-Charge of the Naval Research Establishment Dockyard Laboratory, H.M.C. Dockyard, Halifax, Nova Scotia.

MR. T. ROSENQVIST has left America, and his future address will be: Department of Metallurgy, The Technical University of Norway, Trondheim, Norway.

MR. J. SAWKILL has recently obtained the degree of Ph.D. of Durham University and is now at the Postgraduate School of Physical Metallurgy at the University of Sheffield.

MR. C. SUSSMANN resigned his position as Joint Managing Director of the Anglo Metal Co., Ltd., on 31 October 1951.

MR. E. V. TULL has left the Military College of Science, Shrivenham, and is carrying out research at University College, Swansea.

PROFESSOR H. K. WORNER, Honorary Corresponding Member to the Council for Australia, spent about two weeks

during November in England on his way home from the World Metallurgical Congress in Detroit. He was entertained to dinner by Members of Council, to whom he outlined the present position of metallurgical industry and research in Australia.

MR. H. W. WORNER, a senior research officer of the C.S.I.R.O., working in the Baillieu Laboratory of Melbourne University, has been awarded the Syme Research Prize for 1951 for his work on titanium and its alloys. Several of Mr. Worner's papers have recently been published in the Institute's *Journal*, the latest of them appearing in the present issue.

JOINT ACTIVITIES

Proceedings of General Discussion on Heat Transfer

The Conference for a General Discussion on Heat Transfer arranged jointly by the Institution of Mechanical Engineers and the American Society of Mechanical Engineers in co-operation with a large number of kindred societies in Britain (including the Institute of Metals), the British Commonwealth, and Europe, was held in London on 11, 12, and 13 September and was continued at Atlantic City, N.J., U.S.A., on 26, 27, and 28 November. Ninety-three papers were presented, dealing with developments in the mechanism of transference of heat and in the design of apparatus relating thereto, and the subject-matter for consideration was divided into five main group headings covering the field of discussion, as follows:

(1) heat transfer with change of state;
(2) heat transfer between fluids and surfaces;
(3) conduction in solids and fluids;
(4) radiation, instrumentation, measurement techniques, and analogies;
(5) special problems such as heat transfer in turbine blade cooling, in liquid metals, in gas turbines, and in piston engines, the mercury boiler, &c.

The bound volume of the Proceedings of the Conference (including discussions in London and in Atlantic City) will form a comprehensive and up-to-date treatise on the developments which have taken place during the past ten years within the field of heat transfer covered by the papers. As heat transfer is of universal importance, these Proceedings should be of value to interested parties in all branches of science and industry and to engineers in particular. Copies may be ordered at £2 5*s*. each (post free) and are expected to be ready early in 1952. They may be obtained from the Secretary, The Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.

NEWS OF LOCAL SECTIONS AND ASSOCIATED SOCIETIES

Official Visits by the President

The President, accompanied by the Secretary, will pay official visits to the Sheffield Local Section on Tuesday, 5 February, and to the Scottish Local Section on Monday, 11 February.

London Local Section

The annual meeting of the Section at the Royal School of Mines, London, S.W.7, was held on 8 November, when Professor C. S. BARRETT, of the Institute for the Study of Metals, Chicago, lectured on:

Transformations in Metals

The lecturer outlined the characteristics of martensitic transformations, as contrasted with transformations of the nucleation and growth type, and emphasized that the atomic shifts were highly systematic only in the former. The consequences of these co-operative atom movements were discussed; the change in shape of the transforming regions and the resulting strains in the surrounding untransformed metal were illustrated by slides.

After a review of the effects of plastic deformation on the martensitic transformation in lithium and in steels, some new observations on the transformation in cobalt–nickel alloys were presented. Alloys containing up to 30% nickel underwent the very simple change from the cubic type of close packing to the hexagonal type on cooling and the reverse change on heating, with marked temperature hysteresis between the two changes. It was shown that plastic deformation had pronounced and understandable effects on this transformation, by means of which an equal-stability line on the phase diagram was established in a range of temperatures much too low for equilibrium to be reached by annealing. The microstructures in these and in analogous alloys were compared with the striking and intricate ones resulting from the cubic-to-tetragonal transformation in indium–thallium alloys, and the shearing movements accounting for the structures were explained.

Scottish Local Section

DR. J. M. ROBERTSON, of C. A. Parsons and Co., Ltd., Newcastle-upon-Tyne, read a paper before the Section in Glasgow on 12 November, entitled:

Metals for Gas Turbines

The lecturer began with some general remarks on the trend of properties of materials at high temperatures. The phenomenon of precipitation-hardening was described, and its influence on these properties discussed. He then mentioned the other changes which take place in steels at elevated temperatures, covering spheroidization, graphitization, temper-brittleness, formation of sigma phase, and carbide changes.

Dr. Robertson had prepared and circulated a list of 36 alloys used for gas turbines. These were classified into eight groups: five steel, two nickel-base, and one cobalt-base. The particular features of the materials were described from the point of view of their oxidation- and creep-resistance.

The audience included several members who were engaged on the manufacture and testing of materials for gas turbines, and there was a lively discussion.

Sheffield Local Section

The first meeting of the session was held in the Mappin Hall, The University, on 15 October 1951. The meeting, a joint one with the Sheffield Society of Engineers and Metallurgists, was addressed by Dr. H. M. FINNISTON, Head of the Metallurgy Division, Atomic Energy Research Establishment, Harwell, on the subject of:

Radioactive Tracers in Metallurgy

The lecturer explained the nature of radioactive isotopes and defined some of the terms associated with radioactivity, alpha and beta particles, gamma rays, half-life, curie, roentgen, &c. Some of the properties of beta and gamma emitters were illustrated with P^{32} and I^{131} sources.

The principles of detection of the particles or photons emitted on radioactive decay were illustrated on instruments incorporating Geiger–Müller tubes and on nuclear photographic plate. The precautions to be taken in using these techniques for qualitative and quantitative research work based on radioactive-tracer methods, and the limitations of these techniques were detailed.

Attention was drawn to the new development in autoradiographic measurements in metallurgical applications, where advantage was taken of the preferential adsorption of active ions at particular constituents on the surface. This avoided the difficulties of specimen preparation and of fogging from the underlying layers of metal.

Examples were given of the use of tracers in experiments involving diffusion in the solid and gaseous states; the distribution of specific elements in alloys in micro- and macro-structural applications; corrosion in both gas- and liquid-phase reactions; and in process control. These applications were illustrated by experiments in the Metallurgy Division at Harwell.

Reference was also made to the use of radioactive substances as thickness gauges and as radioactive sources replacing radium. The lecture ended with a résumé of the health precautions to be taken.

At a joint meeting with the Sheffield Metallurgical Association held at the Grand Hotel, Sheffield, on 23 October, Dr. T. A. Taylor, of the National Gas Turbine Establishment, lectured on:

The Problem of Materials for High-Temperature Gas Turbines

The need for extending the temperature range in which gas-turbine materials had useful properties was illustrated by considering the effect of temperature on thermal efficiency and specific output. The improvement of creep-resisting alloys during the present century was traced, and a survey of the properties of present-day alloys showed that only small additional improvements could be expected from alloys based on iron, nickel, or cobalt.

Substantial improvements in high-temperature strength were more likely to arise from the use of more refractory substances as the basic constituent. Some of the known materials of potential use were the refractory metals, ceramic materials, and metal–ceramic mixtures. Of the refractory metals, molybdenum, chromium, and titanium appeared to be the most suitable. There were, however, considerable difficulties to be overcome before these metals or their alloys could be utilized; in the case of molybdenum the chief obstacle was to provide adequate resistance to oxidation, while with chromium alloys the problem was to prevent excessive contamination with oxygen, nitrogen, and other elements during manufacture. The properties at elevated temperatures of the titanium alloys so far investigated were not encouraging. Under the heading of ceramic materials had now to be included the refractory carbides, borides, nitrides, and silicides, as well as the sintered oxides and the conventional ceramics bonded with a glassy phase. The characteristics of these substances were compared, with particular reference to their strength at elevated temperatures, oxidation-resistance, and ability to withstand thermal shock. German, American, and British investigations in this field were reviewed.

Dr. Taylor believed that the addition of a metal phase to a ceramic material might increase its resistance to thermal shock and enable engineers to accommodate brittle materials more easily in their designs. At present, attention was mainly concentrated on carbides and oxides bonded with a variety of metals. Studies of the bonding mechanism suggested the desirability of solid-solution or compound formation between the two phases.

The properties of the materials so far investigated led to the belief that the turbine inlet temperature could be raised to about 1100° C., provided that the problems of thermal shock and reduction of stress concentration could be mastered.

The alternative method of using higher temperatures—that of turbine cooling—was also the object of intensive study and involved many interesting metallurgical problems. Turbine blades consisting merely of a hollow shell could not be cooled to a sufficient extent, and an increase of the effective internal cooling area was required. The techniques of powder metallurgy and of investment casting by the "lost-wax" process had been invoked to produce turbine blades with a multiplicity of longitudinal holes, of the order of 0·030 in. dia. Another method consisted of brazing inserts of large secondary surface area into holes of larger diameter; porous material made from metal powder might also be incorporated in the cooled blade. By the use of these cooling techniques it was believed that turbine inlet temperatures could also be raised to about 1100° C. in the near future.

South Wales Local Section

The first meeting of the new session was held at the University College, Swansea, on 9 October 1951, when Dr. H. M. Finniston, Head of the Metallurgy Division, Atomic Energy Research Establishment, Harwell, gave a lecture on:

Metallurgical Problems of Atomic Energy

The lecturer said that to achieve industrial development of nuclear energy required research covering the extraction, fabrication, and physical, chemical, and mechanical properties of at least five comparatively new metals, plutonium, uranium, thorium, beryllium, and zirconium, but that he would describe a very few of the investigations of the Metallurgy Division, Harwell, and only those of general metallurgical interest.

One important project was concerned with the plastic deformation of uranium, one of the basic fissile elements, which is orthorhombic up to 660° C. At temperatures up to approximately 350° C. the metal deforms by twinning and slip. From 350° to 660° C. slip is the chief operative mechanism. Twinning occurs on four families of planes (one of which is irrational) and slip on two planes (but one of these infrequently). The "habits" of twins in uranium were illustrated, and some indication given of the atomic movements involved in the plastic deformation of the metal.

To illustrate some aspects of the alloying behaviour of the heavy elements, features of the uranium–molybdenum system and the systematics of the Laves phases AB_2, where A is an element in Groups IVA, VA, or VIA (and includes uranium) and B = Fe, Mn, Ni, Co, &c., were discussed. For Laves phases of this type, the electron : atom ratio was apparently of importance in deciding the type of crystal structure assumed by the compound.

In exploring the methods of fabricating some of the elements mentioned above, powder-metallurgy techniques had been tried. One problem of interest was the entrapping of gas in

the interparticle voids on cold pressing before sintering. Experiments had shown that the pressure of air entrapped in metal-powder compacts increased with increasing compacting pressure and could reach 20 atmospheres on pressing at 80 tons/in.^{2}. The violent release of this pressure could account for the reported cracking of cold-pressed compacts during manufacture, and the entrapped gas, if chemically reactive with the metal, could affect subsequent sintering behaviour.

In the ceramic field, a study had been made of the sintering characteristics of UO_2, since this could assume importance as a fissile material. The marked influence on sintering behaviour of additional dissolved oxygen to give the non-stoichiometric composition UO_2–$UO_{2\cdot2}$ was commented on, and the implications of this phenomenon on ceramic processing in general were discussed.

The search for special materials for process metallurgy had produced crucibles of lime, tungsten carbide, &c., samples of which were shown. It had been found that the hygroscopic nature of lime crucibles, which militated against their use, was a function of the density of the lime after fabrication to shape. Crucibles of near-theoretical density could be left in the open air for some days without breakdown.

Finally, the problem of the effects of particle and gamma irradiation on the properties of metals was considered. In these investigations the approach had in most cases to be novel, since experiments had to be done under restrictions introduced by radioactivity and limitations of size and accessibility of experimental space in the reactor. Examples of the measurement of creep, using an air-flow extensometer device, and of the elastic properties of metals by the time-keeping qualities of a watch, were given.

At a meeting on 6 November, Dr. J. C. CHASTON, Deputy Research Manager, Johnson, Matthey and Co., Ltd., addressed the Section on:

Pressing and Sintering Metal Powders

A short account was given of the principal methods used today for making metal powders and the characteristic shapes of the particles produced by each were illustrated. In pressing power-metal compacts, it was emphasized, the powder did not flow like a liquid, and some of the procedures developed —such as the use of floating dies and lubricants—for securing uniformity of density were described. When a compact was formed, the particles cohered as a consequence of cold welding; but the causes of the shrinkage and consolidation which usually resulted from sintering at high temperatures were less clearly understood. The possible effects of recrystallization, evaporation-condensation, surface diffusion, volume diffusion (by the movement of vacant lattice sites), and plastic flow were described, particular attention being directed to the effects of entrapped gas. The differences between the behaviour of a pinholed aluminium casting and a powder-metal compact on prolonged heating were discussed; the progressive consolidation which was observed only in the latter might perhaps be explained by the persistence in the powder-metal product of channels which allowed gases to escape from the cavities.

OTHER NEWS

Plastic Deformation of Metals

A special course on "Plastic Deformation of Metals" will be held in the Department of Metallurgy, The University, St. George's Square, Sheffield 1, from Monday, 31 March to Friday, 4 April 1952, inclusive. The course is intended primarily for industrial scientists, and will include both lectures and practical work. The more fundamental aspects of the deformation of metals will be surveyed, and where possible the results will be related to practice. Further information and application forms may be obtained from The Registrar, The University, Sheffield 10.

1952 International Foundry Congress

The 1952 International Foundry Congress and Show will be held in Atlantic City, N.J., from 1 to 7 May next. In the preceding two weeks a study tour of the principal U.S. foundry centres is being arranged for visitors. The Congress will be held in conjunction with the 56th Annual Meeting of the American Foundrymen's Society.

DIARY

The Institute

3 January. Visit to the Aitchison Metallurgical Laboratories, Birmingham University, Birmingham 15, at 10.30 a.m. (Admission by ticket, obtainable from the Secretary of the Institute.) Informal Discussion on "Tool and Die Materials for the Extrusion of Non-Ferrous Metals and Alloys", Birmingham University, Birmingham 15, at 2.30 p.m.

Local Sections

3 January. London. "Research on the Working of Metals", by W. C. F. Hessenberg. (4 Grosvenor Gardens, London, S.W.1, at 7.0 p.m.)

14 January. Scottish. Visit to a works laboratory with modern equipment for testing materials.

15 January. Oxford. Chairman's Address: "Metallurgical Problems Associated with Atomic Energy", by Dr. H. M. Finniston. (7.0 p.m.)

15 January. South Wales. "Metallurgy and Transport", by T. Henry Turner. (Metallurgy Department, University College, Singleton Park, Swansea, at 6.30 p.m.)

24 January. Birmingham. Discussion on Productivity. (James Watt Memorial Institute, Great Charles Street, Birmingham 3, at 6.30 p.m.)

Other Societies

2 January. Institution of Works Managers, Bristol Branch. "Management in a Research Organization", by G. L. Bailey. (Grand Hotel, Bristol, at 7.15 p.m.)

3 January. Leeds Metallurgical Society. "The Platinum Metals, Their Properties and Uses", by Dr. J. C. Chaston. (Chemistry Department, The University, Leeds 2, at 7 p.m.)

7 January. Institute of British Foundrymen, Sheffield Branch. "Synthetic Resins as Foundry Sand Binders", by P. G. Pentz. (Sheffield College of Technology, Department of Engineering, Pond Street, Sheffield 1, at 7.30 p.m.)

8 January. Institute of British Foundrymen, Burnley Section. "Phosphor Bronze", by E. Jackson. (Accrington Grammar School, Blackburn Road, Accrington, at 7.30 p.m.)

9 January. Manchester Metallurgical Society. "Cast Iron", by Dr. J. E. Hurst. (Engineers' Club, Albert Square, Manchester, at 6.30 p.m.)

11 January. Liverpool Metallurgical Society. "The Use of Radioactive Tracers in Metallurgical Research", by Dr. H. M. Finniston. (Lecture Theatre, Electricity Service Centre, Whitechapel, Liverpool, at 7 p.m.)

12 January. Institute of British Foundrymen, Lancashire Branch. "Some Examples of Loam Moulding, Ferrous and Non-Ferrous", by E. Clipson. (Engineers' Club, Albert Square, Manchester, at 3 p.m.)

15 January. Institute of British Foundrymen, East Anglian Section. Brains Trust. (Central Hall, Public Library, Ipswich, at 7.0 p.m.)

15 January. Institute of British Foundrymen, Slough Section. "Modern Melting Practices", by F. C. Evans. (Lecture Theatre, High Duty Alloys, Ltd., Slough, at 7.30 p.m.)

16 January. Institute of British Foundrymen, North-East Scottish Section. "Cross-Section of a Non-Ferrous Jobbing Foundry", by J. Gorman. (Imperial Hotel, Arbroath, at 7.30 p.m.)

17 January. Institution of Mining and Metallurgy. General Meeting. (Geological Society, Burlington House, Piccadilly, London, W.1, at 5.0 p.m.)

21 January. Institute of Metal Finishing, London Centre. "Non-Electrolytic Smoothing Treatment for Steel", by W. A. Marshall. (Northampton Polytechnic, St. John Street, London, E.C.1, at 6.0 p.m.)

23 January. Manchester Metallurgical Society. General Discussion and Exhibition on "Microscopy", to be opened by J. D. Hannah. (Engineers' Club, Albert Square, Manchester, at 6.30 p.m.)

25 January. Institute of Metal Finishing, Sheffield and North-East Centre. "Tin–Zinc Deposition", by J. S. Bowden. (Grand Hotel, Sheffield, at 6.30 p.m.)

25 January. West of Scotland Iron and Steel Institute. "Die Forging" by J. D. Latta. (39 Elmbank Crescent, Glasgow, C.2, at 6.45 p.m.)

30 January. Institute of British Foundrymen, London Branch. Short address on "The Implementation of the Garrett Report", by Colin Gresty, to be followed by a paper and film on "The Observation and Control of Dust in Foundry Operations", presented by W. B. Lawrie. (Waldorf Hotel, Aldwych, W.C.2, at 7.0 p.m.)

30 January. Institute of Welding. "Metal Spraying", by W. E. Ballard, J. Barrington Stiles, and V. E. Stanbridge. (Institution of Civil Engineers, Great George Street, London, S.W.1, at 6 p.m.)

APPOINTMENTS VACANT

CHEMISTS AND METALLURGISTS are invited by the MINISTRY OF SUPPLY to apply for the following posts, in the SCIENTIFIC OFFICER CLASS, at a research establishment in Berkshire. (1) (Ref. F.886/51/A). Physical metallurgist with sound knowledge of modern metallurgical theory. Experience in metallography or in the determination of thermal and physical properties essential. (2) (Ref. F.887/51/A). Physical or inorganic chemist preferably with some experience of radioactive chemistry. Candidates should have a first- or second-class honours degree in chemistry or metallurgy. Applicants for the senior grade must be at least 26 years of age and should have at least 3 years' post-graduate research experience. Grade and salary will be assessed according to age, qualifications, and experience within the ranges: Senior Scientific Officer £720–£910; Scientific Officer £380–£620. Rates for women somewhat lower. The posts are unestablished but carry benefits under F.S.S.U. Application forms obtainable from the Ministry of Labour and National Service, Technical and Scientific Register K, Almack House, 26–28, King Street, London, S.W.1, quoting appropriate reference. Closing date 29 January, 1952.

CHEMIST for metallurgical analyses, should preferably have experience with high-speed steel, for factory in the Midlands. Good opportunity for man with initiative. Write in confidence, stating age, experience, and salary required, to Box No. 319, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

EXPERIENCED METALLURGIST required for research dept., in North-West area. Must have personality and ability to control Inspection Section, as well as technical qualifications of normal average calibre. Permanent position. Apply Box 323, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

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METALLOGRAPHIC ASSISTANT. A vacancy exists for a male assistant in Metallographic Laboratory. Applicants should have completed military service and be between 20 and 30 years of age. School certificate essential; other qualifications an advantage. Previous experience of metallography or photography not necessary but an advantage. Salary according to age, experience, and qualifications. Applications to British Cast Iron Research Association, Bordesley Hall, Alvechurch, Birmingham.

METALLURGIST, preferably with experience of the alumino-thermic process, for development work and control of production for factory in the Midlands. Write in confidence, stating age, experience, and salary required, to Box No. 318, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

METALLURGIST required as Assistant Manager for aluminium gravity die foundry. Good laboratory training and personality more important than foundry experience. Age 25–35. John Dale, Ltd., London Colney, St. Albans.

METALLURGIST required for investigations on non-ferrous alloys in Research Division of Laboratory attached to Founders in the London Area. Applicants should have a good degree in metallurgy or equivalent qualifications, or alternatively, a degree in physics or chemistry with metallurgical experience. Salary according to qualifications and experience. Write to Box No. 316, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

SENIOR METALLURGIST required to take general charge of research on bearing metals, bronze and other alloys containing tin. Industrial experience an advantage. The post is one of responsibility and will be suitably remunerated. F.S.S.U. superannuation. Applications to be sent to The Director, Tin Research Institute, Fraser Road, Perivale, Greenford, Middlesex.

TECHNICAL ASSISTANT required for Metallurgical Research Dept., experience in metallurgy of light alloys essential and possession of Higher National or equivalent certificate desirable. Age about 21–23. Apply in writing with full particulars to, Secretary, Magnesium Elektron, Ltd., Lumm's Lane, Clifton Junction, Nr. Manchester.

APPOINTMENT REQUIRED

METALLURGIST 27, seeks appointment—research or industry. Four and a half years' experience (2 years in U.S.A.). Papers published. Box No. 322, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

For publication in January 1952

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By JOHN LUMSDEN, B.Sc.

(Research Department, Imperial Smelting Corporation, Ltd.)

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